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ABSTRACT

This study investigated the cognitive processes involved in picture interpretation as pictorial realism (i.e., iconic stimulus complexity) increases. Variables influencing cognitive efficiency in picture interpretation were analyzed, particularly field independence and ideational fluency. Field independence is the extent to which a surrounding framework dominates imbedded item perception, and ideational fluency is the divergent production of semantic units, a determinant of the way an observer uses pictorial stimulus cues to direct categorizing. Stimulus materials based on those of Dwyer included an audiotaped script, edited and with additional prompts, and 37 slides. Results suggest that field independence and ideational fluency are important cognitive skills in pictorial stimuli interpretation. (Field independence is primarily an evaluative, analytic, problem-solving skill, rather than a perceptual disembedding skill.) As stimulus complexity increases, different psychological processes are involved in their interpretation, depending somewhat on the learning task. Support for the superiority of the simple line drawing over the realistic photograph treatment was provided by this study, which is consistent with the results of previous research. Twelve references are cited. (LMM)

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THE DIFFERENTIAL EMPLOYMENT OF COGNITIVE SKILLS AS A FUNCTION OF INCREASING ICONIC STIMULUS COMPLEXITY

by

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The Differential Employment of Cognitive Skills As A Function of Increasing Iconic Stimulus Complexity

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The Problem

The problem under investigation in this study had two aspects:

1. As iconic stimulus complexity ("realism") increases, are the cognitive processes involved in picture interpretation differentially employed (i.e., are there significant aptitude-treatment interactions between selected cognitive skills and "realism")?

2. If so, are the interactions dependent upon, or independent of, the type of learning the student is expected to demonstrate (i.e., are there significant aptitude-treatment-task interactions)?

Related Literature

A Model Of Picture Interpretation Behavior

The theoretical framework for the study was provided in part by Higgins' (1975) "Model of Picture Interpretation Behavior." The model integrates previous work by Piaget (e.g., 1950) on the nature and development of intelligence, and by Gagne (e.g., 1966) on problem solving.

The model suggests that picture interpretation comprises two interrelated events: observation and inference-drawing. Observation includes processes such as deployment of attention, perception, and initial categorization of stimuli on the basis of "formal" attributes. Inference drawing involves further categorization, not necessarily on the basis of observable attributes, and generalization to other non-visual states and events. Inference drawing is "going beyond the information given" (Higgins, 1975).

The picture interpretation model comprises a large number of cognitive activities. The efficiency and effectiveness with which these activities are executed appears to be mediated by a number of individual difference variables. Two of these -- field independence and ideational fluency -- were selected for further study.

Individual Differences in Picture Interpretation

Field Independence, which is described in detail by Witkin, et al., (1977), considers the extent to which a surrounding framework dominates the perception of an item within it. It is the "ability to overcome embedding contexts of perceptual functioning" (Goodenough, 1976, p. 675). Thus field independence should play an important role in the observation stage of the model.

In addition to its role as a variable mediating perceptual disembedding, field independence (as the Convergent Production of Figural Transformations) has been associated with the redefinition, recombination, and modification of arrangement of perceived elements (Guilford, 1959, cited in Nunnally, 1967). These are acts of categorization associated with the inference drawing stage of the model of picture interpretation.

Field Independence was indicated by performance on the Group Embedded Figures Test (Witkin, et al., 1971). The test involves disembedding and tracing a simple figure hidden within a complex geometric display. Split-half reliability with Spearman-Brown correction was .837 in this study.

Ideational Fluency also appears to be involved in the interpretation of pictures, in "the conceptual dissection of more cue-laden stimuli of which pictures, especially realistic pictures, are representative" (Higgins, 1978). Ideational fluency involves the Divergent Production of Semantic Units (Nunnally, 1967, pp. 454-455); i.e., the searching of episodic memory(Ekstrom, et al., 1967, p. 67), and the recalling and selecting of conceptual material.

In terms of the picture interpretation model, ideational fluency (the Divergent Production of Semantic Units) would seem to be a determinant of the way in which an observer uses available cues from the iconic stimulus to direct his categorizing. Agility in category generalization would allow the subject to take fullest advantages of the available cues.

Ideational Fluency was measured by performance on the Topics Test. The test comprises two parts of four minutes each. Given a topic, the subject's task is to write as many ideas about the topic as possible. Split-half reliability with Spearman-Brown correction was .936.

In this study, the correlation between the aptitude measures was .087.

"Realism" In Instructional Materials

Dwyer's Systematic Program of Evaluation (e.g., 1978) has amassed a large body of evidence that offers convincing support for the theoretical position that "for the promotion of specific educational objectives, visuals possessing realistic detail beyond a certain point add very little or actually decrease student learning" (Dwyer, 1978, p. 8). More cues may simply complicate the disembedding, encoding, and categorization tasks -- often to the point that unless the student possesses a highly developed set of the cognitive skills requisite to performance of those tasks, achievement declines.

Procedure

Design

The study was designed as an aptitude-treatment-task-interaction experiment which investigated the interactions of several individual difference variables on two

types of cognitive tasks, as complexity of iconic stimuli increased over two treatment levels. The design also allowed investigation of the extent to which aptitudes interact with each other, as well as with treatments.

For the analysis, a three factor multivariate analysis of variance was employed. The three factors were (1) Iconic Complexity (i.e., "realism"); (2) Field Independence; and (3) Ideational Fluency. Each had two levels: "High" and "Low," in the cases of the aptitude variables; "Simple Line Drawing" and "Realistic Photograph" for the treatment variable. Dependent variables were scores on tests of drawing and comprehension. Significant main effects and interactions were followed up by constructing simultaneous confidence intervals, and by conducting univariate analyses of covariance.

The stimulus materials used were based on those used by Dwyer (e.g., 1976), and included an audiotaped script accompanied by thirty-seven 2 X 2 photographic slides. The subject was "Structure and Function of the Heart." The script was edited to delete some verbal information and to include prompts to attend to the visuals.

Subjects

Forty subjects, all prospective trainees at the Naval Hospital Corps School at Great Lakes, Illinois, completed the entire study. None had begun the school's curriculum at the time the study was conducted. The sample included 22 males and 18 females representing eighteen states and every major geographic area of the country. The mean age of subjects was 20.25 years; the mean number of years' education was 12.3. Subjects were randomly assigned to two groups prior to administration of the treatments.

Analysis

The multivariate analysis showed that there was a significant main effect of Stimulus Complexity and a significant second-order interaction effect involving complexity, field independence, and ideational fluency. Other main effects and interactions were not significant.

Simultaneous confidence intervals were constructed as a follow-up to the significant MANOVA. Because of the relatively small N, power was a special concern. After MANOVA, univariate analyses of covariance were conducted on each dependent variable and (1-beta) power coefficients were obtained. For the drawing test, power of the 3-way ANCOVA was about 0.65; for the comprenension test, about 0.90. Patterns of significance were identical to those observed in MANOVA. The power of MANOVA to detect actual differences among group centroids was in the vicinity of 0.75 - 0.80 -- sufficiently high to continue the analysis.

Results*

Results Involving the Drawing Test

Significant differences in achievement on the Drawing Test were found between the

*For brevity, the following abbreviations are used:
FI = Field Independence ("Hi" and "Lo" levels)
IF = Ideational Fluency ("Hi" and "Lo" levels)
SLD = Simple Line Drawing treatment
RP = Realistic Photograph treatment

high field independence/low ideational fluency group that received the SLD treatment, and the same group receiving the RP treatment. The source of the main effect for complexity, in favor of the SLD group, seems to be isolated here.

Results Involving the Comprehension Test

The significant second-order interaction appears attributable to the eight groups' performances on the Comprehension Test. Group differences are recapped below:

High Performance Group		Lower Performance Group	Comment
Hi FI - Hi IF - SLD	>	Lo FI - Lo IF - RP	Extreme Groups difference
Hi FI - Lo IF - SLD	>	Lo FI - Lo IF - RP	Weak treatment X FI interaction noted
Hi FI - Lo IF - SLD	>	Hi FI - Hi IF - RP	Weak treatment X IF interaction noted
Hi FI - Lo IF - SLD	>	Lo FI - Hi IF - SLD	In SLD, FI explains 29% of comp. test variance.

Discussion

Results of the study suggest that:

1. Field Independence and ideational fluency are important cognitive skills in the interpretation of pictorial stimuli;

2. In the processing of pictorial information, the primary role of field independence is as an evaluative, analytic, problem-solving skill, rather than as a perceptual disembedding skill;

3. As the complexity of iconic stimuli increases, the psychological processes involved in their interpretation are differentially employed;

4. The differential employment of cognitive skills is dependent, to some degree, on the type of learning the student is expected to demonstrate;

5. Aptitudes may interact with each other, as well as with treatments and tasks; and

6. Overall, the superiority of the Simple Line Drawing treatment over the Realistic Photograph treatment, is confirmed. This is consistent with a large body of previous research.

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